(12) **UK Patent Application** (19) **GB** (11) **2 296 443** (13) **A**

(43) Date of A Publication 03.07.1996

(21) Application No 9526267.1

(22) Date of Filing 21.12.1995

(30) Priority Data
(31) 9416021 (32) 30.12.1994 (33) FR
9501952 16.02.1995

(51) INT CL$^{6}$
A61F 2/38

(52) UK CL (Edition O)
A5R RAK

(56) Documents Cited
US 5330534 A US 4224697 A

(58) Field of Search
UK CL (Edition O) A5R RAJ RAK
INT CL$^{6}$ A61F 2/38

(71) Applicant(s)
JBS SA

(Incorporated in France)

4 Villa Beausoleil, BP 3048, 10000 Troyes, France

(72) Inventor(s)
Pierre Louis Peyrou
Loup De Leobardy
Yves Thirion
Arnaud Legrand
Marc Amel
Francis Demigneux
Alain Noël Dubart

(72) cont
Jean-Francois Jeanson
Yves Catonne
Daniel Lajoie

(74) Agent and/or Address for Service
Rowland Allsop
10 London End, BEACONSFIELD, Bucks, HP9 2JH, United Kingdom

(54) **Sliding knee prosthesis with interchangeable components**

(57) A postero-stabilised sliding knee prosthesis 1 comprises femoral implant 13 and tibial implant 2 with intervening meniscal element 3. Meniscal element 3 has two spherical bearing cavities 31, 32 which receive the outwardly spherical femoral condyles. The separation of the spherical condyles is the same for increasing sizes of femoral implant 17, 18 thus increasing interchangeability of components and reducing the number of components required during surgery.

The tibial plate 21 may also carry a pin (Fig. 7 to 10) which passes through a central indentation in the meniscal element 3 into a hemispherical cavity in the femoral implant 13 between the two condyles.

Also described is a cutting guide for placing the femoral implant (Fig. 15 and 16).

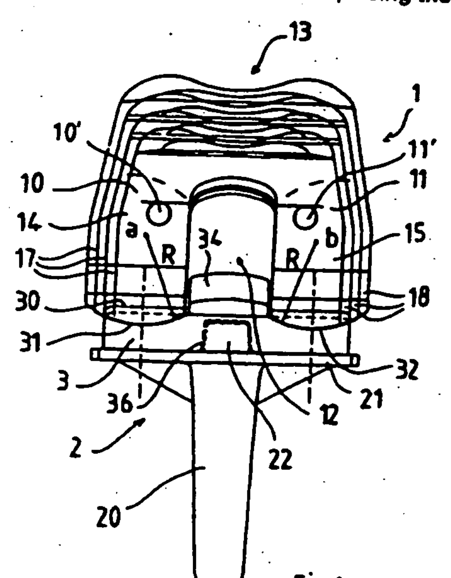



Fig.1

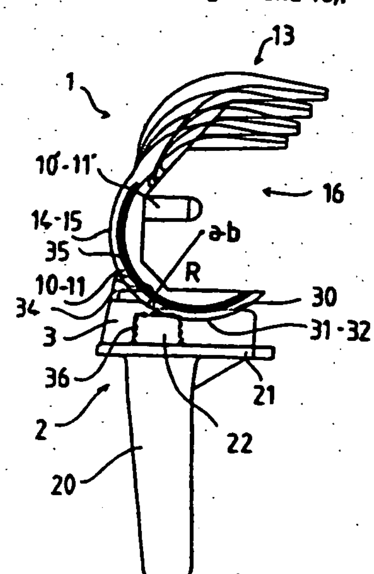



Fig.2

GB 2 296 443

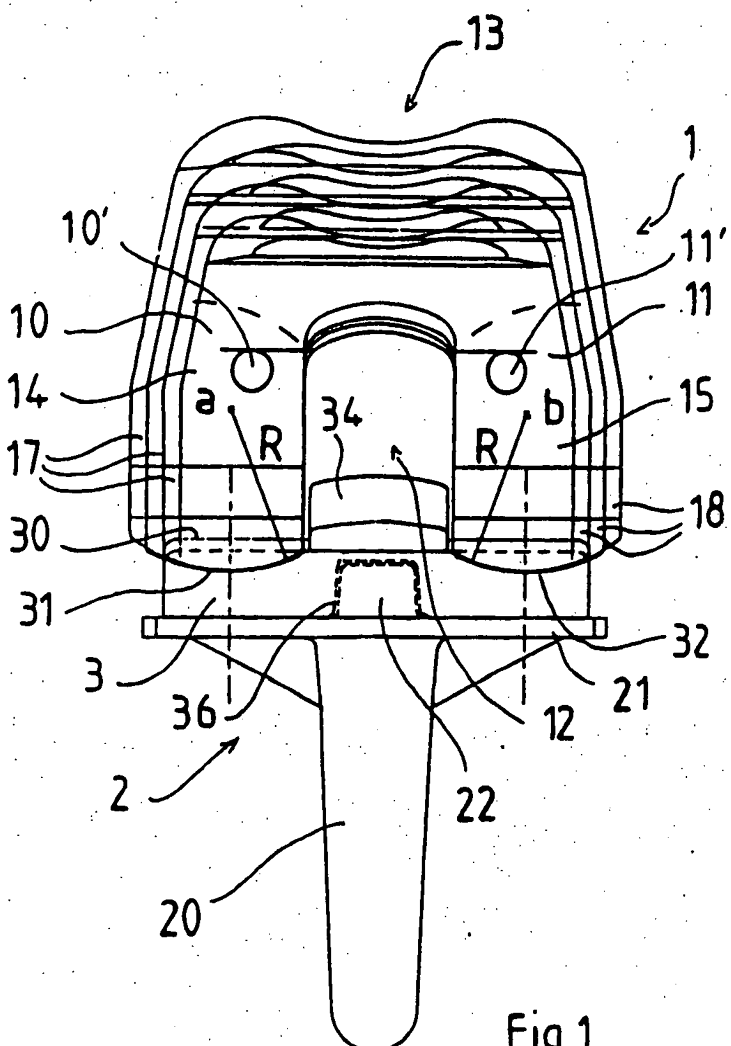

13
1
10'
11'
10
11
14
a
34
b
15
R
R
17
18
30
31
3
36
12
22
32
21
2
20

Fig.1

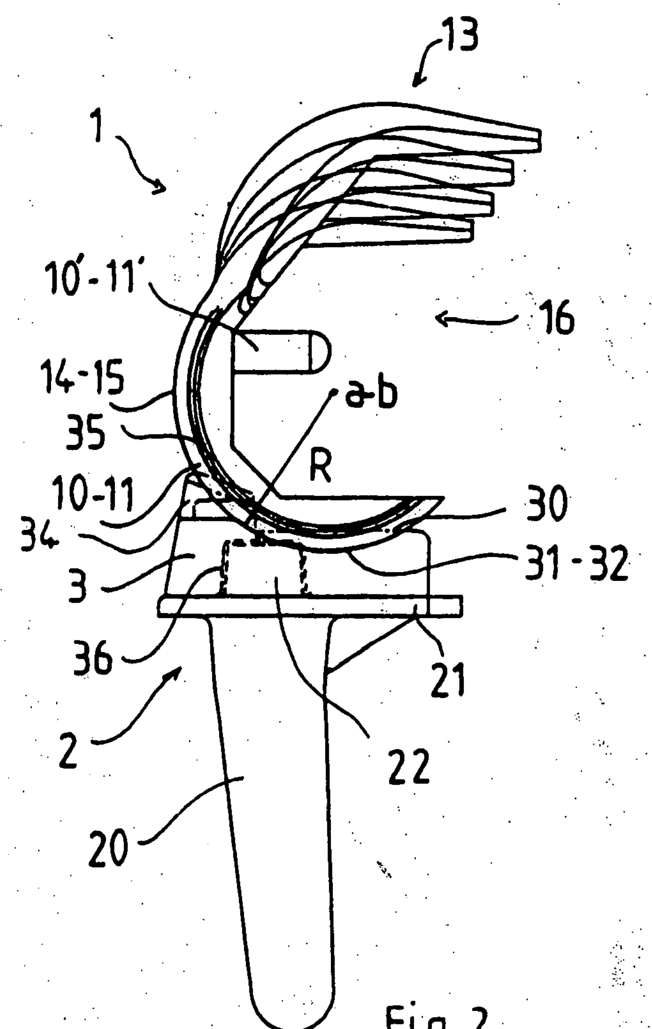

13
1
10'-11'
16
14-15
a-b
35
R
10-11
30
34
31-32
3
36
21
2
22
20

Fig.2

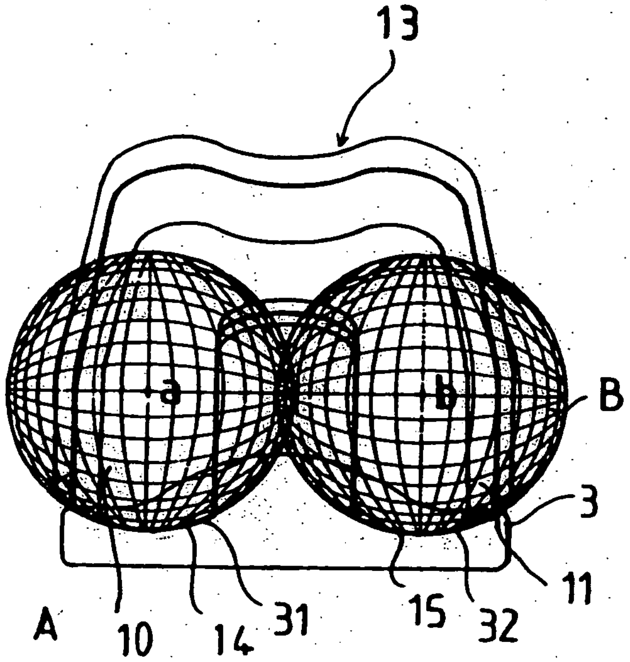



Fig. 3

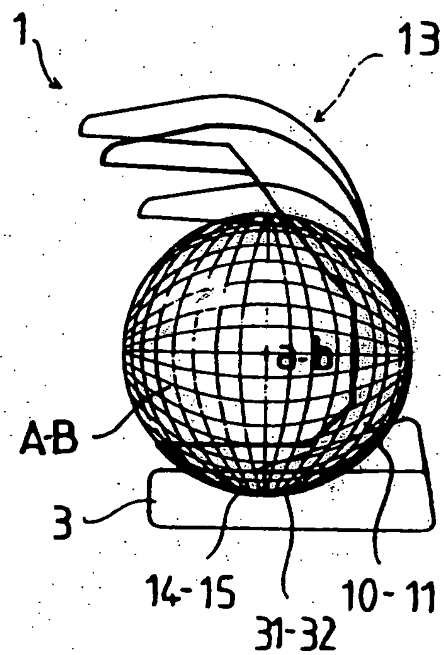



Fig. 4

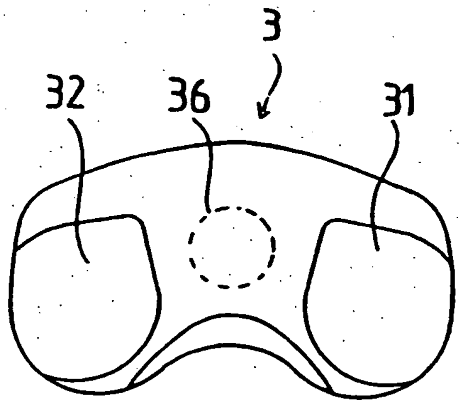



Fig.5

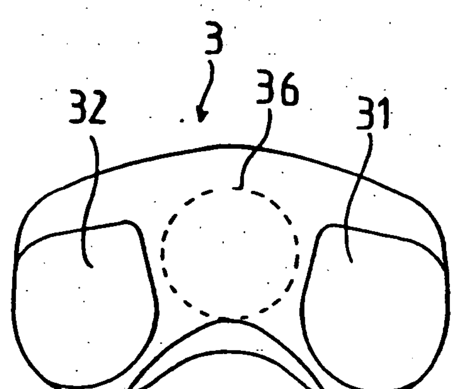



Fig.6

Fig. 7

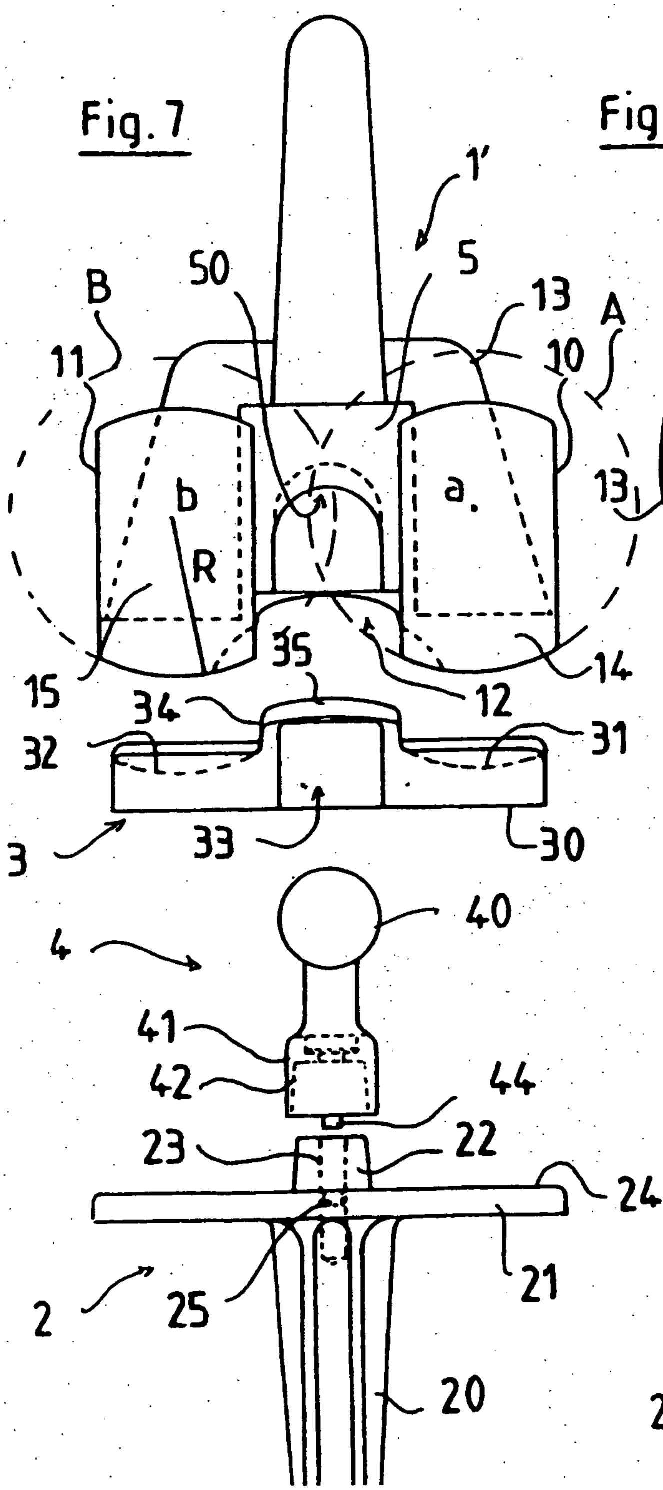

1'
5
50
B
11
13
A
10
b
a
R
15
35
14
12
34
32
31
33
30
3
40
4
41
42
44
23
22
24
25
21
2
20

Fig. 8

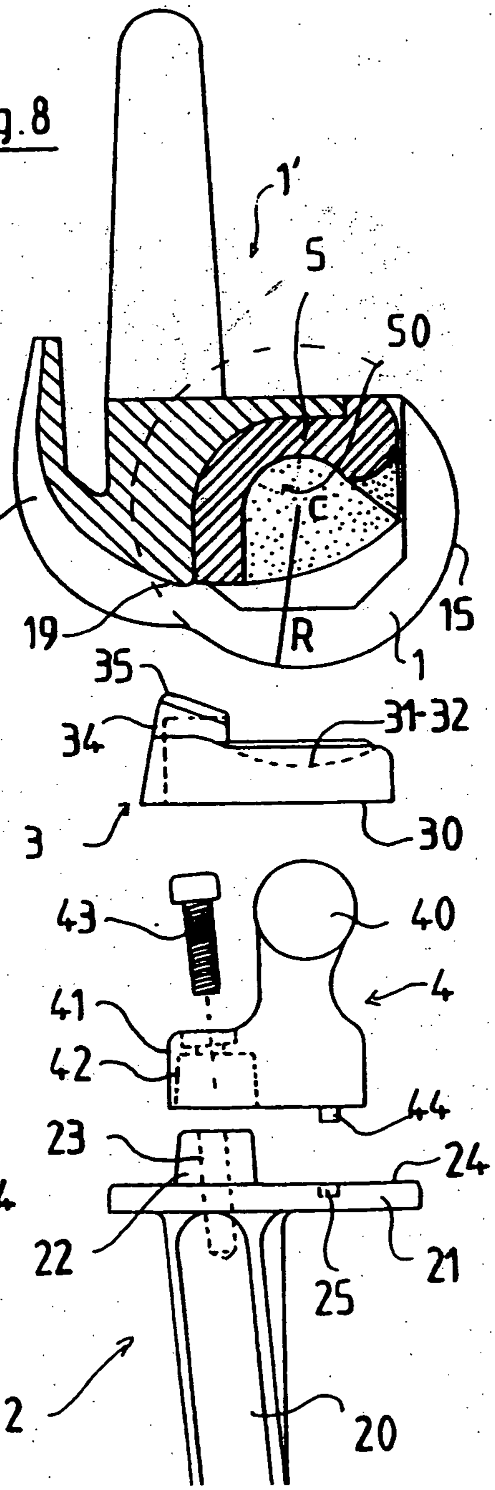

1'
5
50
13
c
15
19
R
1
35
34
31-32
3
30
43
40
4
41
42
44
23
24
22
25
21
2
20

Fig.9

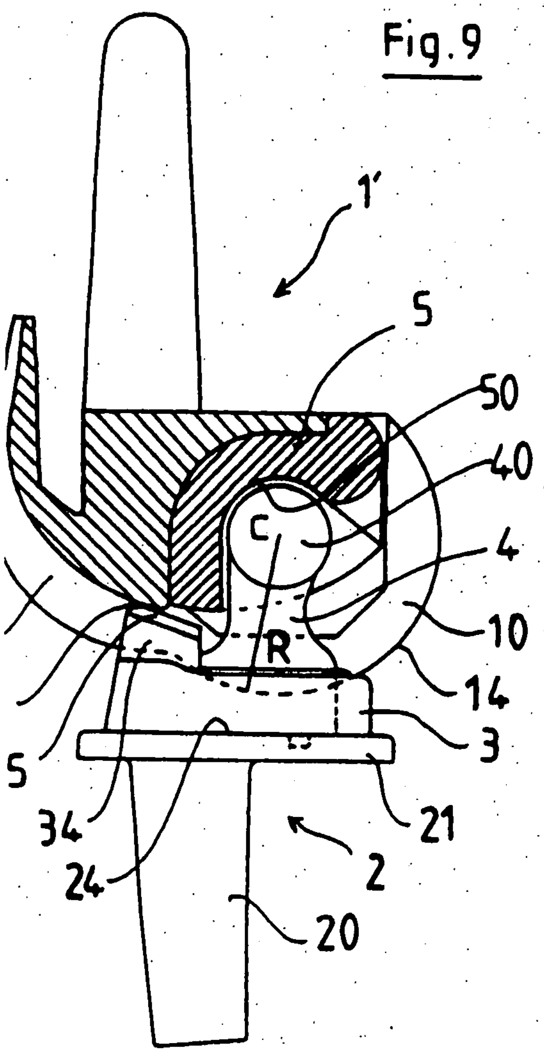
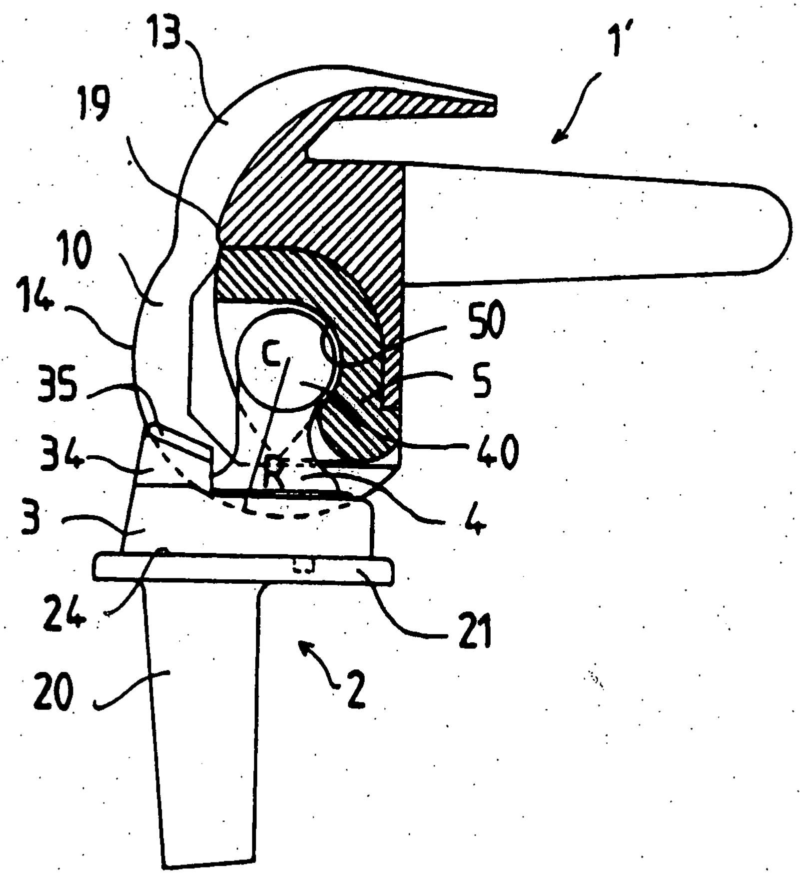

1'
5
50
40
4
10
14
3
21
2
20
24
34
5
C
R

Fig.10


1'
13
19
10
14
35
34
3
24
20
2
21
4
40
5
50
C
R

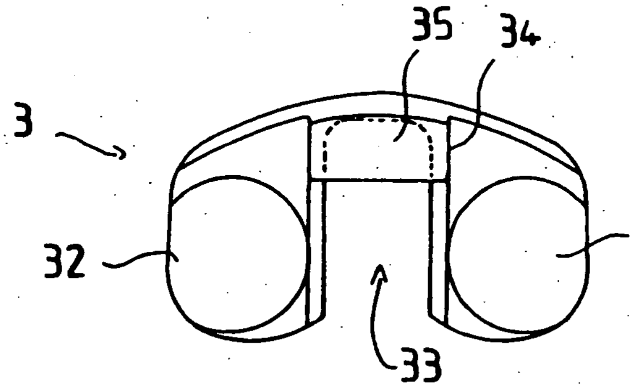



Fig.11a

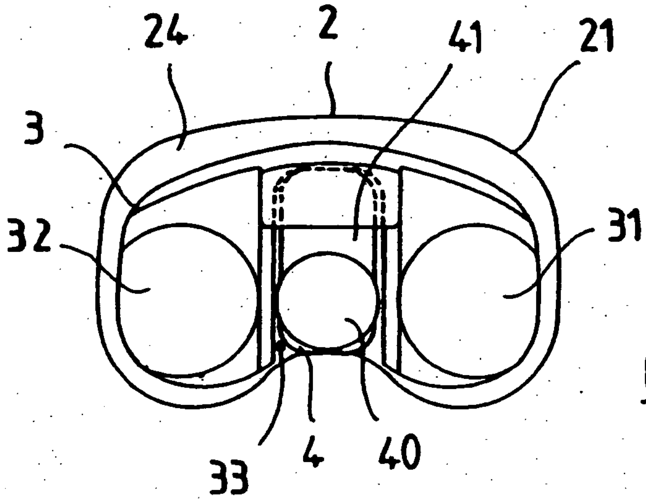



Fig.11b

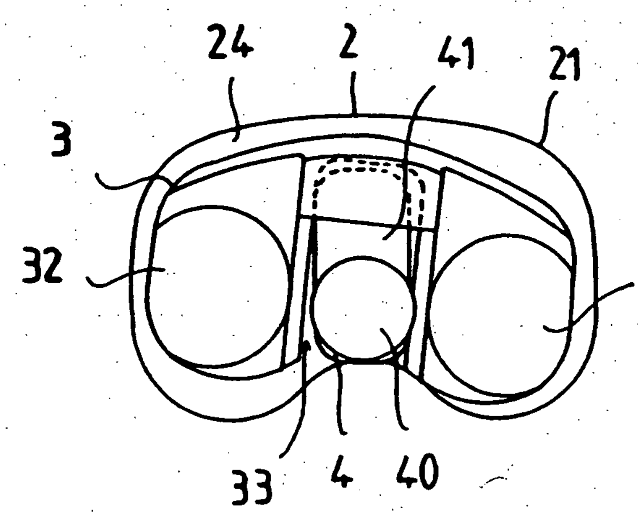



Fig. 11b

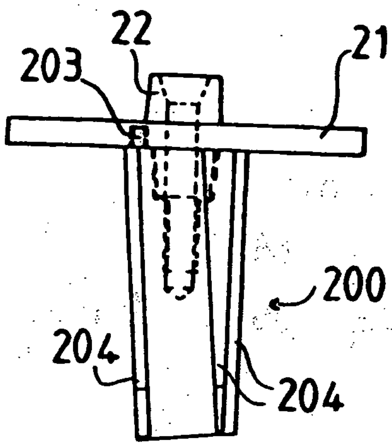



Fig.12a

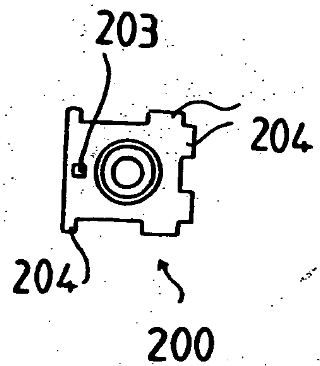



Fig.12b

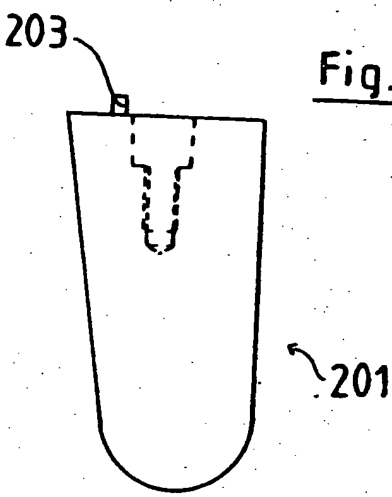



Fig.13a

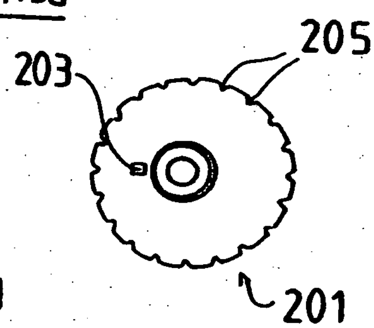



Fig.13b

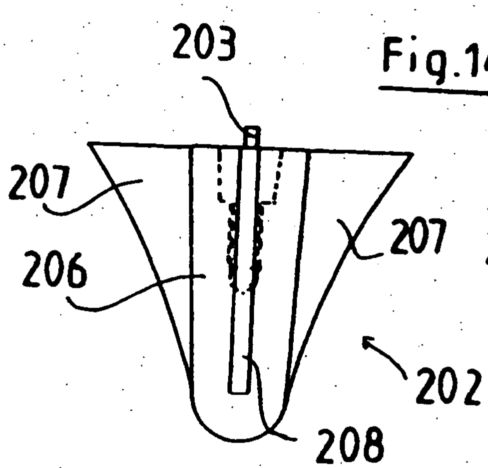



Fig.14a

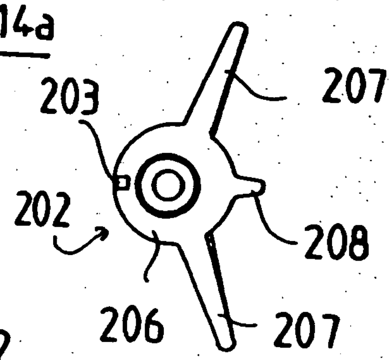



Fig.14b

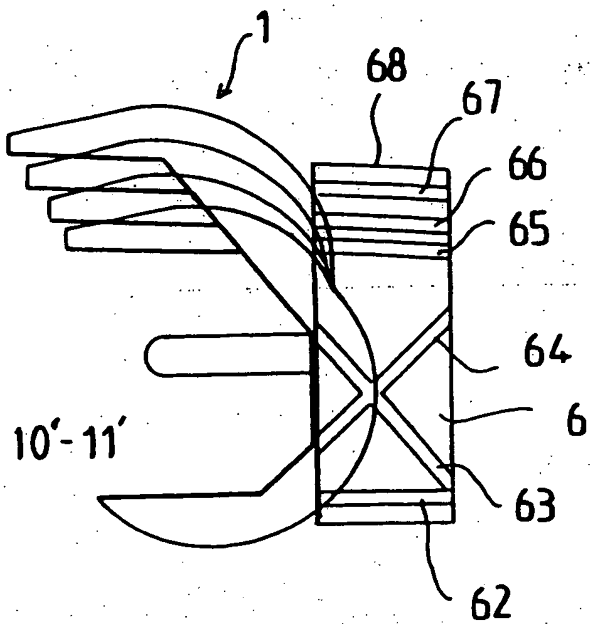



Fig. 15

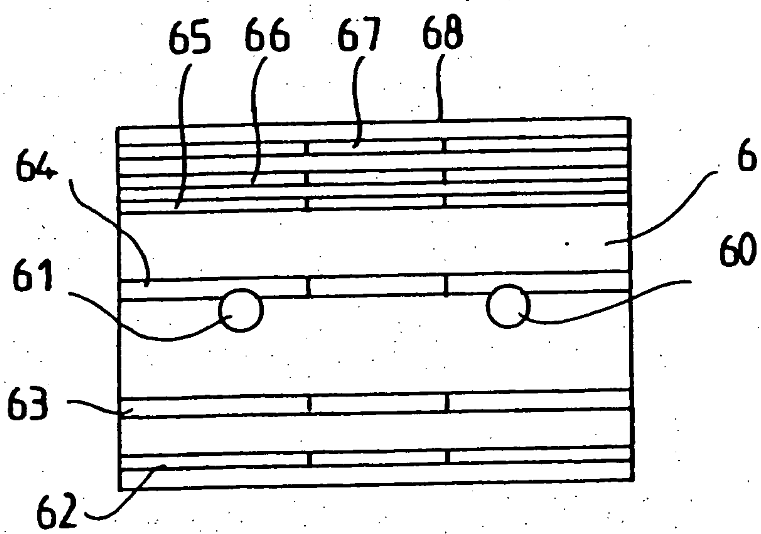



Fig. 16

2296443



The object of the present invention is a sliding knee prosthesis which can be used as a postero-stabilised prosthesis, particularly when used as a replacement prosthesis.

Knee protheses existing at present all comprise a femoral implant made up of two condyles and a trochlea, and a tibial implant the plate of which is covered by a meniscus element, mobile or otherwise, on which the condyles rest and can slide.

To enable a prosthesis to be adapted to the anatomy of a patient, it is necessary to have femoral and tibial implants of different sizes.

Furthermore, in order to conform to ligament tensions, it is necessary to have meniscus elements of different thicknesses, which increases the number of parts needed for an operation.

On the other hand, the knee joint can be subject to dislocations, or pulling, due to slackness of the ligaments or the accidental absence thereof, particularly the posterior cruciate ligament.

Slackness of the ligaments is generally found in the case of a replacement, that is to say during the insertion of a prosthesis to replace another implanted previously.

To overcome the disadvantages of anterior pulling and lateral slackness, a postero-stabilised prosthesis has been proposed, that is to say one comprising, approximately at the centre of the tibial plate, a central spur against which abuts, on flexion, a transversal part positioned in the intercondylar indentation. Prostheses of this type are described in documents US-A-950 298 and GB-A-1 067 412.

Postero-stabilised prostheses existing at present can only prevent anterior pulling in flexion and are almost exclusively reserved for cases in which the posterior cruciate ligament is absent.

Prostheses have also been proposed which have, approximately in the centre of the tibial plate, a pin provided with a sphere on its end cooperating with a hemispherical cup placed in the femoral implant. Such prostheses, described in particular in

documents US-A-3.868.730 and GB-A-2.088.724, nevertheless have disadvantages of comfort and durability.

Indeed, in the prosthesis which is the object of document US-A-3.868.730, the articulation is produced on one hand between the condyles and the meniscus plate, and on the other hand between the sphere and the cup, which causes ligament tension problems, accentuated if one or other of the friction surfaces is prematurely worn.

The prosthesis described in document GB-A-2 088 724 uses a sphere only as a stop, the articulation being produced between the condyles and the tibial plate. This prosthesis, however, has the disadvantage of a possible phenomenon of shearing between the condyles and the plate during axial pivoting, involving the risk of premature wear of the friction surfaces. In addition, flexion is limited due to the fact that the cup is extended to the rear to prevent pulling on extension.

In addition, as the radius of the condyles is not constant, it is necessary to provide mobility for the spherical head, which is obtained by attaching it to a piston, with the disadvantages of this type of device.

The aim of the present invention is to overcome these disadvantages by proposing a sliding knee prosthesis which can be adapted to replacements and to postero-stability, enabling the number of parts needed in a surgical operation to be reduced considerably.

A prosthesis according to the present invention comprises a femoral implant, a tibial implant and a meniscus element. It is characterised essentially, first of all, by the fact that the meniscus element has two spherical bearing cavities, and secondly by the fact that the femoral implant has two condyles, the bearing surfaces of which are spherical segments of different centres and with a radius equal to that of the spherical cavities, these centres being separated, irrespective of the size of the femoral implant, by the same distance, enabling the dimensions of the meniscus element, with the exception of the

thickness, to be constant whatever the size of the implant.

According to an additional characteristic of the prosthesis according to the invention, the meniscus element has on its top surface, in the anterior central area, an abutment having on top a backward sloping plane against which rests the base of the trochlea at the end of the intercondylar indentation when the knee is in extension.

According to a further additional characteristic of the prosthesis according to the invention, the tibial plate has on its flat top surface a truncated cone shaped projection which is housed in a cavity provided in the bottom flat surface of the meniscus element, permitting, according to the size and shape of this cavity, the said meniscus element to pivot in rotation or slide freely over the said tibial plate.

In one particular mode of realisation of the prosthesis according to the invention, a pin, the end of which is provided with a spherical head, is fixed on the tibial plate in the posterior central area thereof, the centre of the said spherical head being aligned with the centres of the spherical segments comprising the condyle bearing surfaces; the meniscus plate, attached to the said tibial plate, being indented at the centre to permit the said pin to pass with clearance, while an insert having a hemispherical cavity, in which the spherical head of the said pin fits without clearance, is inserted and secured in the femoral implant between the two condyles, opposite the intercondylar indentation.

According to a first variant of this mode of realisation of the prosthesis according to the invention, the cavity of the insert retains when the knee is in extension.

According to a second variant of this mode of realisation of the prosthesis according to the invention, the cavity of the insert does not retain in extension, so as to permit distal clearance between the femoral implant and the tibial implant.

The spherical headed pin used in this mode of realisation of the prosthesis according to the invention, can be attached to

the tibial plate by a Morse taper type of fixture complete with a screw, in association with an anti-pivoting spur.

The screw fixing the said pin to the tibial plate also permits an intramedular pin to be fixed to the said plate, the shape and dimensions of this pin being adapted to the anatomy of the patient and the quality of the bone material.

The pin is also fixed to the tibial plate by a Morse taper type fixture supplemented by an anti-pivoting spur.

The prosthesis according to the invention offers the advantage over known prostheses of perfect congruence between the meniscus element and the condyles for flexion, and between the meniscus element and the tibial plate for rotation.

It offers the additional advantage of enabling the number of parts needed for a surgical operation to be reduced considerably since it requires only the femoral implants to be of different dimensions and meniscus elements which only differ in thickness.

The prosthesis according to the invention also enables the instruments to be limited, in particular requiring only one cutting guide, due to the fact that, irrespective of the size of the femoral implant, the anchoring pins thereof are equidistant while the posterior cut and the bevel are the same, only the height of the anterior cut being variable.

In the simplest configuration of the prosthesis according to the invention, the dimensions and shape of the lower cavity of the meniscus element are different from those of the truncated cone shaped projection of the tibial plate. This allows the said meniscus element to move over the tibial plate, while maintaining perfect congruence of the meniscus element with the condyles on one hand, and with the tibial plate on the other.

Postero-stability of the prosthesis according to the invention is obtained by using a meniscus plate in which the dimensions and shape of the lower cavity correspond to those of the truncated cone shaped projection of the tibial plate, which allows the meniscus element alone to pivot around the said

projection.

In the case of a repeat prosthesis, that is to say comprising a spherical headed pin and an insert, the articulation is produced firstly between the condyles and the meniscus element and secondly between the spherical head and the insert.

The choice of whether the cavity of the insert retains or not depends on the state of the ligaments, a retaining cavity enabling the insert and the spherical head to act as a ball and socket, preventing dislocation.

The advantages and characteristics of the present invention will be more clearly understood from the description which follows, which refers to the appended drawings depicting several modes of non-limitative realisation.

In the appended drawings:

- Figure 1 represents a front view of a prosthesis according to the invention, in a position if flexion at 90°, showing several femoral implants of different sizes.

- Figure 2 shows a side view of the same prosthesis.

- Figure 3 shows, in a front view, a representation of several superimposed femoral implants of the same prosthesis.

- Figure 4 shows the same representation in a side view.

- Figure 5 shows a top view of a meniscus element of a prosthesis according to the invention.

- Figure 6 shows a top view of a variant of the same meniscus element.

- Figure 7 shows an exploded rear view of a prosthesis according to the invention in its postero-stabilised version.

- Figure 8 shows an exploded side view, with partial sections, of the same prosthesis.

- Figure 9 shows a side view, with partial sections, of the same prosthesis in an extended position.

- Figure 10 shows a side view with partial sections of the same prosthesis in a position of flexion at 90°.

- Figure 11a shows a plan view of a meniscus element of the prosthesis shown in figure 7.

- Figure 11b shows a view of a tibial plate equipped with this same meniscus plate.

- Figure 11c shows a plan view of the same tibial plate equipped with the same meniscus plate in a different position.

- Figures 12a and 12b respectively show a side view and a plan view of a first mode of realisation of the tibial implant pin of the prosthesis according to the invention.

- Figures 13a and 13b respectively show a side view and a plan view of a second mode of realisation of the tibial implant pin of the prosthesis according to the invention.

- Figures 14a and 14b respectively show a rear view and a plan view of a third mode of realisation of the tibial implant pin of the prosthesis according to the invention.

- Figure 15 shows a side view of a cutting guide enabling the positioning of a prosthesis according to the invention.

- Figure 16 shows a front view of the same cutting guide.

If one refers to figures 1 and 2 one can see that a prosthesis according to the invention comprises a bicondylar femoral implant 1, a tibial base 2 with a pin 20, and a meniscus element 3.

The femoral implant 1 has two condyles 10 and 11 separated by an intercondylar indentation 12, and extended by a trochlea 13.

The bearing surfaces 14 and 15 of the condyles, 10 and 11 respectively, have a certain curvature in the longitudinal direction and another in the transversal direction, these curvatures being of constant and identical radius R, such that the bearing surfaces 14 and 15 are segments of a sphere of centre a and b respectively.

Figures 3 and 4, which show three superimposed femoral implants 1 of different sizes, give a better understanding of the fact that the bearing surfaces 14 and 15 of the condyles 10 and 11 respectively are, irrespective of the size of the femoral implant 1, spherical sectors of two spheres A and B of centre a and b respectively.

The meniscus element 3, mounted on the plate 21 of the tibial base 2, has on its top surface 30 two spherical cavities 31 and 32 of the same radius R, to support the condyles 10 and 11 respectively while allowing them to slide.

There is complete congruence between the condyles 10 and 11 and the meniscus element 3, irrespective of the angle of flexion.

Figures 1 and 2 show four femoral implants 1 of increasing sizes. This difference in size is shown by an enlargement of the trochlea 13 and the condyles 10 and 11 by external lateral extensions 17 and 18 respectively, while the distance between the centres a and b of the spherical segments which form the bearing surfaces 14 and 15, remains identical irrespective of the size of the femoral implant 1, permitting the same meniscus implant 3 to be used.

It will also be noted that the anchoring pins 10' and 11' of the femoral implant 1 have, irrespective of the size of the latter, identical distances between centres and positions, and that the posterior cut and the bevel required are the same, and that only the height of the anterior cut varies, which will be described in greater detail with figures 15 and 16.

For example, the insertion of a current prosthesis requires for a patient of a given height, four femoral implants of different sizes, one tibial implant and meniscus implants to corresponding dimensions in 5 different thicknesses, i.e. a total of twenty five parts, while a prosthesis according to the invention requires only ten, i.e. four femoral implants, one tibial implant and 5 meniscus elements which do not differ in thickness.

Furthermore, one can see in figures 1 and 2 that the tibial plate 21 has on top in the anterior central area a truncated cone shaped projection 22, which enables the meniscus element 3 either to be fixed or the movement thereof limited, according to the transversal dimensions and shape of the cavity 36 provided in the meniscus element 3 where truncated cone shaped projection 22 is housed, as shown in figures 5 and 6.

Figure 5 shows a meniscus element 3 the shape and dimensions of the cavity 36 of which correspond to the truncated cone shaped projection 22, such that the movement of the meniscus element 3 over the tibial plate 21, not shown, is limited to pivoting, for a postero-stabilised prosthesis for example.

Figure 6 shows a meniscus element 3 the cavity 36 of which is of considerably greater dimensions than those of the truncated cone-shaped projection, which enables the meniscus element 3 to move over the tibial plate 21, not shown.

One can also see in figures 1 and 2 that the meniscus element 3 has, above the anterior part of the indentation 33, an abutment 34 having a sloping plane 35 on top, against which the base 19 of the trochlea 13 rests at the bottom of the intercondylar indentation 14 when the knee is in extension, in order to prevent anterior pulling.

If one refers to figures 7 and 8, one can see that, in the case of a replacement, on the plate 21 of the tibial base 2 is fixed a pin 4 the free end of which is provided with a spherical head 40.

The attachment of pin 4 to plate 21 is performed firstly by fitting, over the truncated cone shaped projection 22 of the plate 21, a front extension 41 of pin 4 which has for this purpose, at the lower end, a truncated cone shaped cavity 42, and secondly by a screw 43 fitted in a tapped hole 23, which also permits the attachment of the pin 20 which is joined on.

To prevent pin 4 from pivoting, a spur 44, protruding under pin 4, is inserted in a hole 25 on the top surface 24 of the plate 21 in its rear central area.

It is to be noted that it may not be possible for the plate 21 to have a hole 25, in which case the spur 44 is positioned at the rear end of pin 4 and fits into the indentation of plate 21 to prevent pin 4 from pivoting.

The meniscus element 3, as can be seen more accurately on figures 11a, 11b and 11c, has a rear central indentation 33 enabling the passage of pin 4 and separating the two spherical

cavities 31 and 32.

Indentation 33 is such that there is some clearance between the pin 4 and the meniscus element 3, so that the latter can slide over the plate 21 and pivot around the extension 41 with a degree of freedom of the order of 10°, as shown in figure 11c.

On figures 7, 8, 9 and 10, one can see that between the condyles 10 and 11 of a femoral implant 1', opposite the intercondylar indentation 12, is inserted and fixed by appropriate means not shown, an insert 5 with a hemispherical cavity 50 designed to house the spherical head 40 of pin 4, the centre c of this hemispherical cavity 50 being aligned with the centres of the spherical segments forming the bearing surfaces 14 and 15 of condyles 10 and 11.

As can be seen in figure 5, the cavity 50 does not retain, that is to say that the spherical head 40 is inserted on the axis of the femoral implant 1' so that it can have distal clearance in extension.

However, in a variant, not shown, the cavity 50 retains in extension, that is to say that the spherical head 40 is inserted towards the rear of the cavity 50 when the knee is in flexion, such that the head 40 and insert 5 act as a ball and socket, holding the femoral implant 1' and the tibial implant 2, which is possible because of the alignment of the centres a, b and c.

The configuration of the prosthesis can be improved by the choice of pin best suited to the anatomy of the patient and to the state of the bone matter.

The choice of pin can be made from among those shown on figures 12a, 12b, 13a, 13a, 13b, 14a and 14b.

In these figures, one can see that pins 200, 201 and 202 are attached to the tibial plate 21, visible only on figure 12a, by a Morse taper type fitting complete with a fixture screw and an anti-pivoting spur 203.

In figures 12a and 12b one can see a pin 200, the transversal section of which is more or less square shaped, comprising, laterally, longitudinal ribs 204.

In figures 13a and 13b one can see a pin 201 of round transversal section, the height of which decreases from top to bottom, and the surface of which is striated with grooves 205, not shown on figure 13a, the depth of which is constant.

In figures 14a and 14b one can see a pin 202 with an approximately cylindrical body 206 comprising radially three wings, two lateral wings 207 and one posterior wing 208, the lateral wings 207 each being at an angle of 70° to the posterior wing 208, wings 207 and 208 being of decreasing width and height towards the bottom, and posterior wing 208 being shorter than the lateral wings 207.

If, finally, one refers to figures 15 and 16 one can see a cutting guide 6 permitting the front and rear cuts and the bevel to be performed for the insertion of the femoral implant 1 irrespective of the size thereof, different sizes being shown on figure 15.

The cutting guide 6 has, firstly, two positioning rods 60 and 61, or holes permitting the insertion of pins, designed to be inserted in the holes bored to house the anchoring pins 10′ and 11′ of the femoral implant 1, and secondly, as a guide for the saw, slots 62, 63 and 64 for the posterior cut and bevels, and three slots 65, 66 and 67 for the anterior cut for three sizes of femoral implant 1, the top edge 68 serving as a guide for a fourth size.

lower surface (30) of the meniscus element (3).

6) A prosthesis according to claim 5 characterised by the fact that the dimensions of the cavity (36) of the meniscus element (3) are greater than the dimensions of the truncated cone shaped projection (22) of the tibial plate (21), so as to permit free sliding movement of the said meniscus element (3) over the said tibial plate (21).

7) A prosthesis according to claim 5 characterised by the fact that the shape and dimensions of the cavity (36) of the meniscus element (3) correspond to the shape and dimensions of the truncated cone-shaped projection (22) of the tibial plate (21), so that the said meniscus element (3) is only permitted to pivot in rotation on the said tibial plate (21).

8) A prosthesis according to any of claims 1 to 4, characterised by the fact that, on one hand, pin (4), the end of which is fitted with a spherical head (40), is fixed on the tibial plate (21) in the rear central area thereof, the centre (c) of the said spherical head (40) being aligned with the centres (a, b) of the spherical segments comprising the bearing surfaces (14, 15) of the condyles (10, 11); on the other hand the meniscus plate (21), attached to the said tibial plate (21), is indented centrally to permit the passage with clearance of the said pin (4); and, furthermore, an insert (5), with a hemispherical cavity (50) into which the spherical head (40) of the said pin (4) fits, without clearance, is inserted and fixed in the femoral implant (1′) between the two condyles (10, 11), opposite the intercondylar indentation (12).

9) A prosthesis according to claim 8, characterised by the fact that the cavity (50) of the insert (5) retains when the knee is in extension, the spherical head (40) being inserted towards the back of the insert (5).

10) A prosthesis according to claim 8 characterised by the fact that the cavity (50) of the insert (5) does not retain when the knee is in extension so as to permit distal clearance, the spherical head (40) being inserted in the said insert (5) on the

CLAIMS

1) A sliding knee prosthesis comprising a femoral implant, a tibial implant and a meniscus element, characterised firstly by the fact that the meniscus element (3) has two spherical bearing cavities (31, 32), and secondly by the fact that the femoral implant (1) has two condyles (10, 11) the bearing surfaces of which (14, 15) are spherical segments of different centres (a, b) and of radius (R) equal to that of the spherical cavities (31, 32), the said centres (a, b) being separated, irrespective of the size of the said femoral implant (1), by the same distance, permitting the meniscus element (3), with the exception of the thickness, to be of constant dimensions whatever the size of the femoral implant (1).

2) A prosthesis according to claim 1 characterised by the fact that the anchoring pins (10', 11') of the femoral implant (1) are of identical distances between centres and positions irrespective of the size of the femoral implant (1).

3) A prosthesis according to claim 1 or claim 2 characterised by the fact that the anterior cut and the bevels necessary for placing the femoral implant (1) are identical irrespective of the size of the said femoral implant (1), only the height of the anterior cut being variable.

4) A prosthesis according to any of the foregoing claims characterised by the fact that the meniscus element (3) has on its top surface, in its front central area, an abutment (34) having at the top a sloping plane (35) against which rests the base (15) of the trochlea (13) at the tip of the intercondylar indentation (12) when the knee is in extension.

5) A prosthesis according to any of the foregoing claims characterised by the fact that the tibial plate (21) comprises on its flat top surface (24) a truncated cone-shaped projection (22) designed to be housed in a cavity (36) provided on the flat

axis of the femoral implant (1').

11) A prosthesis according to any of claims 8, 9 and 10, characterised by the fact that the pin (4) is attached to the tibial plate (21) by a Morse taper type fixture complete with a screw (43), associated with an anti-pivoting spur (44).

12) A prosthesis according to any of claims 8 to 11, characterised by the fact that the indentation (33) of the meniscus element (3) is of dimensions such that there is some clearance between the pin (4) and the meniscus element (3), so that the said meniscus element (3) can slide over the tibial plate (21) and pivot around the pin (4) with a degree of freedom of the order of 10°.

13) A prosthesis according to any of the foregoing claims, characterised by the fact that the pin (200, 201, 202) of the tibial implant (2) is attached to the tibial plate (21) by a Morse taper type fixture complete with a fixing screw and an anti-pivoting spur (203).

14) A cutting guide permitting the placing of the femoral implant (1) of the prosthesis according to any of claims 1 to 7, characterised by the fact that it has two positioning rods (60, 61), and guide slots (62, 63, 64) for a saw for performing the posterior cut and the bevels, and saw guide slots (65, 66, 67) for performing the anterior cut according to the size of the said femoral implant (1).

The Patent Office

4

**Application No:** GB 9526267.1
**Claims searched:** 1 to 13

**Examiner:** Mr S.J.Pilling
**Date of search:** 21st March 1996

## Patents Act 1977
## Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): A5R (RAK, RAJ)

Int Cl (Ed.6): A61F 2/38

Other: -

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | | Relevant to claims |
|---|---|---|---|
| X:Y | US 5330534 | Column 2 line 58 to column 3 line 2, column 4 line 52 to column 5 line 14, column 9 lines 56 to 62, the figures, particularly Figures 4 and 6a. | X:1,4,5<br>Y: 8,9,12 |
| Y | US 4224697 | See the abstract, column 11 lines 34 to 41 and the figures particularly Figures 3 to 5. | 8,9,12 |

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
& Member of the same patent family
A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.